NAVAL FACILITIES ENGINEERING COMMAND

CONTRACTOR CRANE AWARENESS TRAINING

2001

WHY BOTHER WITH CONTRACTOR CRANES?

CRANE REFERENCES

REFERENCES

1. COE 385-1-1

SECTION 16 C through 16 L

APPENDIX "G" Operator Qualification Requirements

APPENDIX "H" Inspection Criteria

APPENDIX "I" Performance Test Requirements

2. OSHA 1910 General Industry Standards

OSHA 1926. Subpart N

3. ASME 30.5 Mobile Cranes

ASME 30.22 Articulating Boom Cranes

4. NAVFAC P-307 Management of WHE (Sept. 2001)

5. Contract Specification Section 01525

CONTRACTING OFFICER

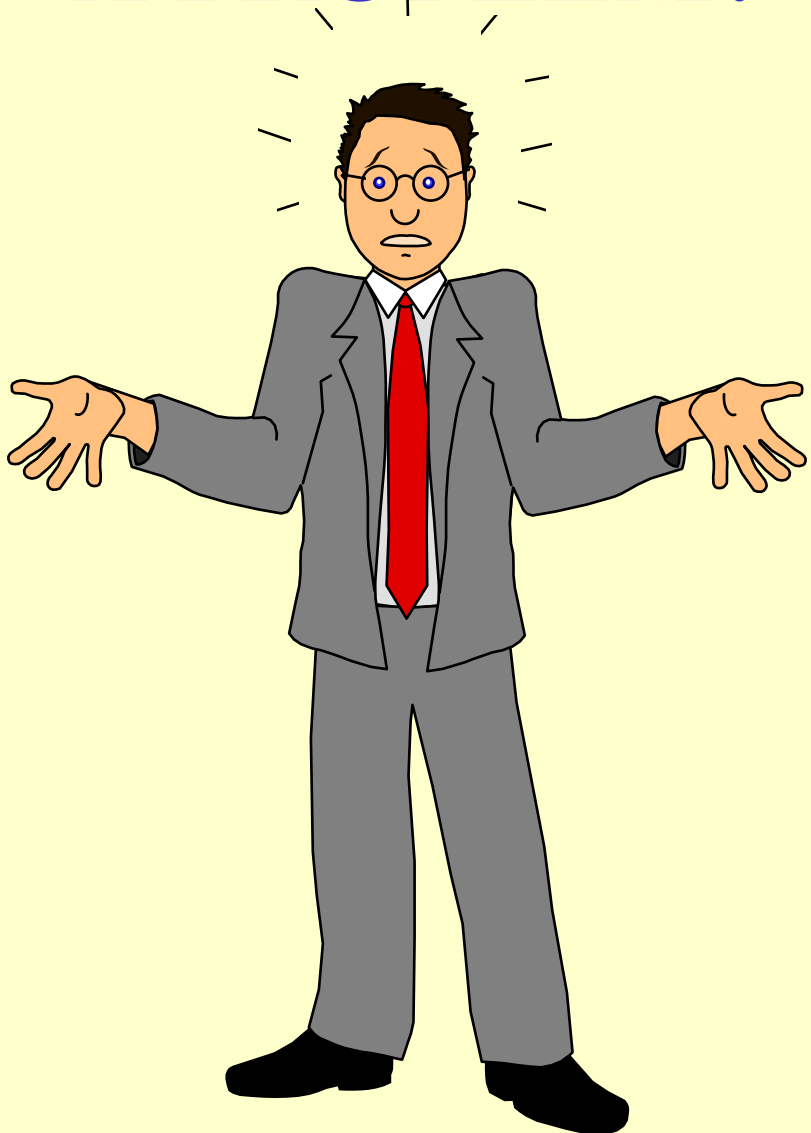
CONTRACTING OFFICER IS RESPONSIBLE FOR CRANES USED IN SUPPORT OF CONTRACTS

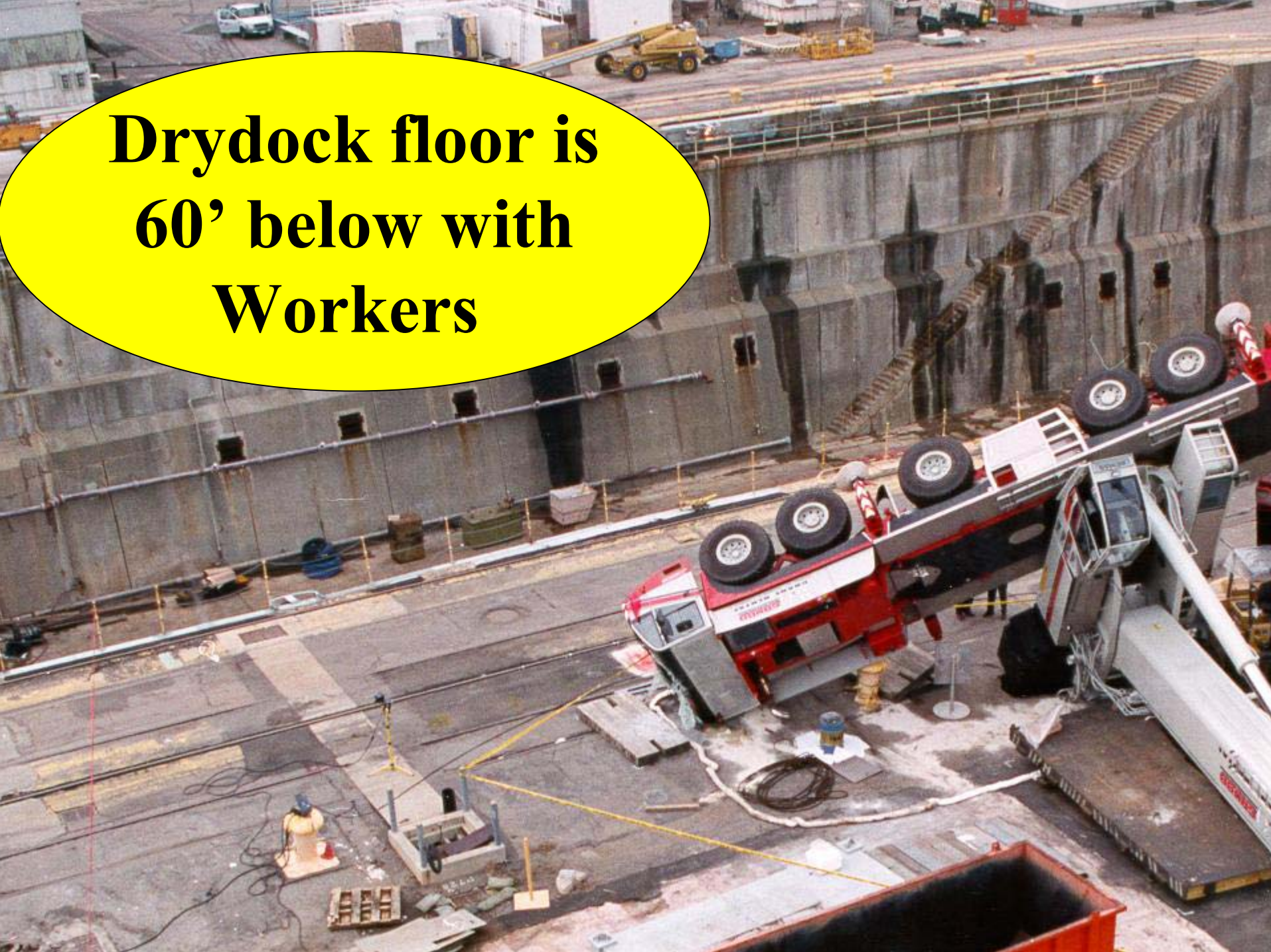
- FOLLOW P-307, PARAGRAPH 1.7
- FOR CONSTRUCTION CONTRACTS USE EM 385-1-1
- FOR ALL OTHER CONTRACTS:
  - OSHA REGULATIONS
  - ASME STANDARDS
- SHOULD ENGAGE SERVICES OF CRANE GROUP TO ENSURE CRANES AND OPERATIONS ARE SAFE

WHAT WE NEED TO KNOW ABOUT CRANES

CRANE INSPECTION BASICS
MANDATORY SAFETY DEVICES
TYPE OF CRANES
CRANE ASSEMBLY & SET-UP
OPERATOR QUALIFICATIONS
WATERFRONT CRANE RQ'MTS.

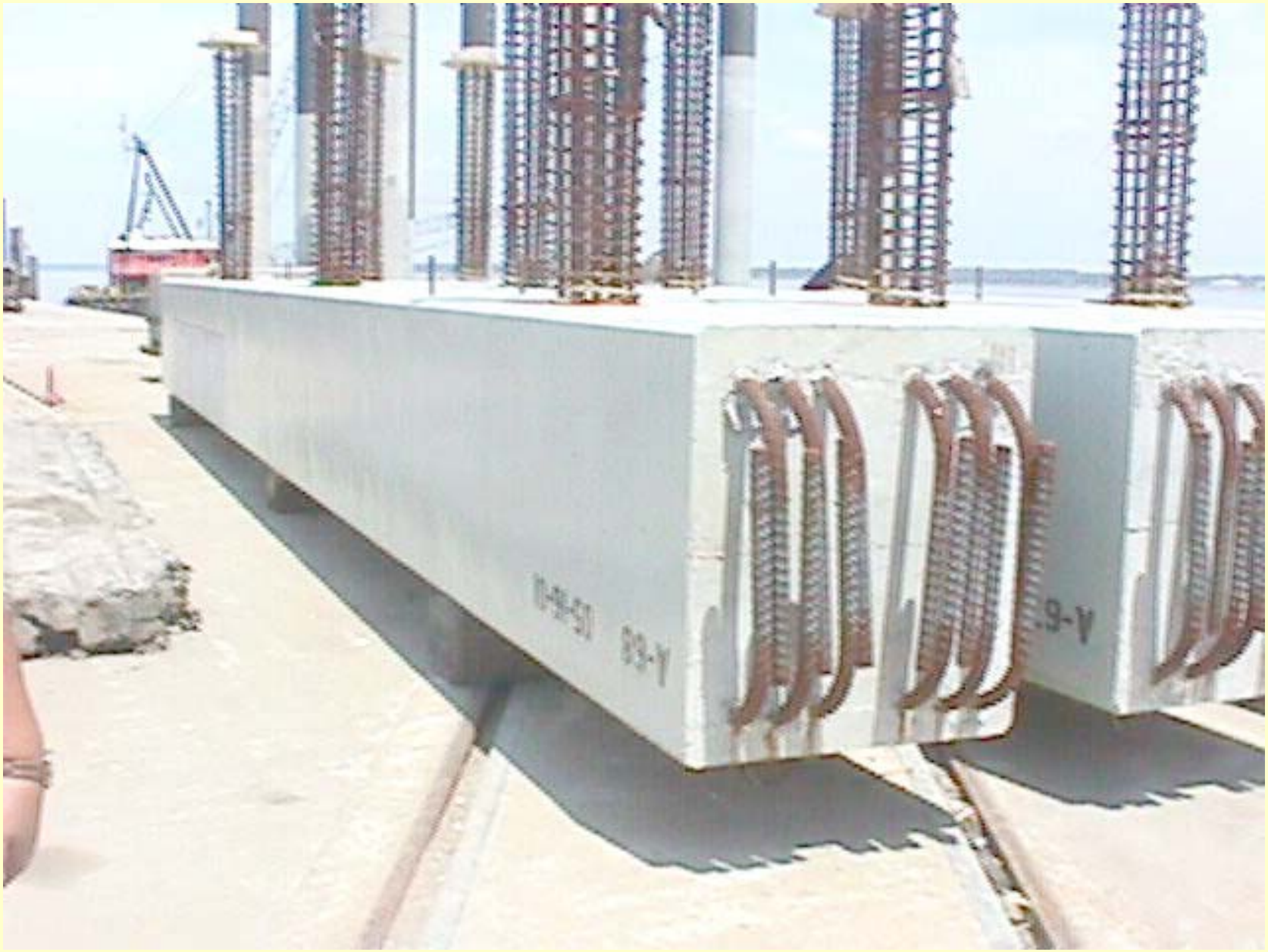
ARE CRANE ACCIDENTS REALLY A PROBLEM?




Drydock floor is
60’ below with
Workers

Crane Accident

18 July 2001



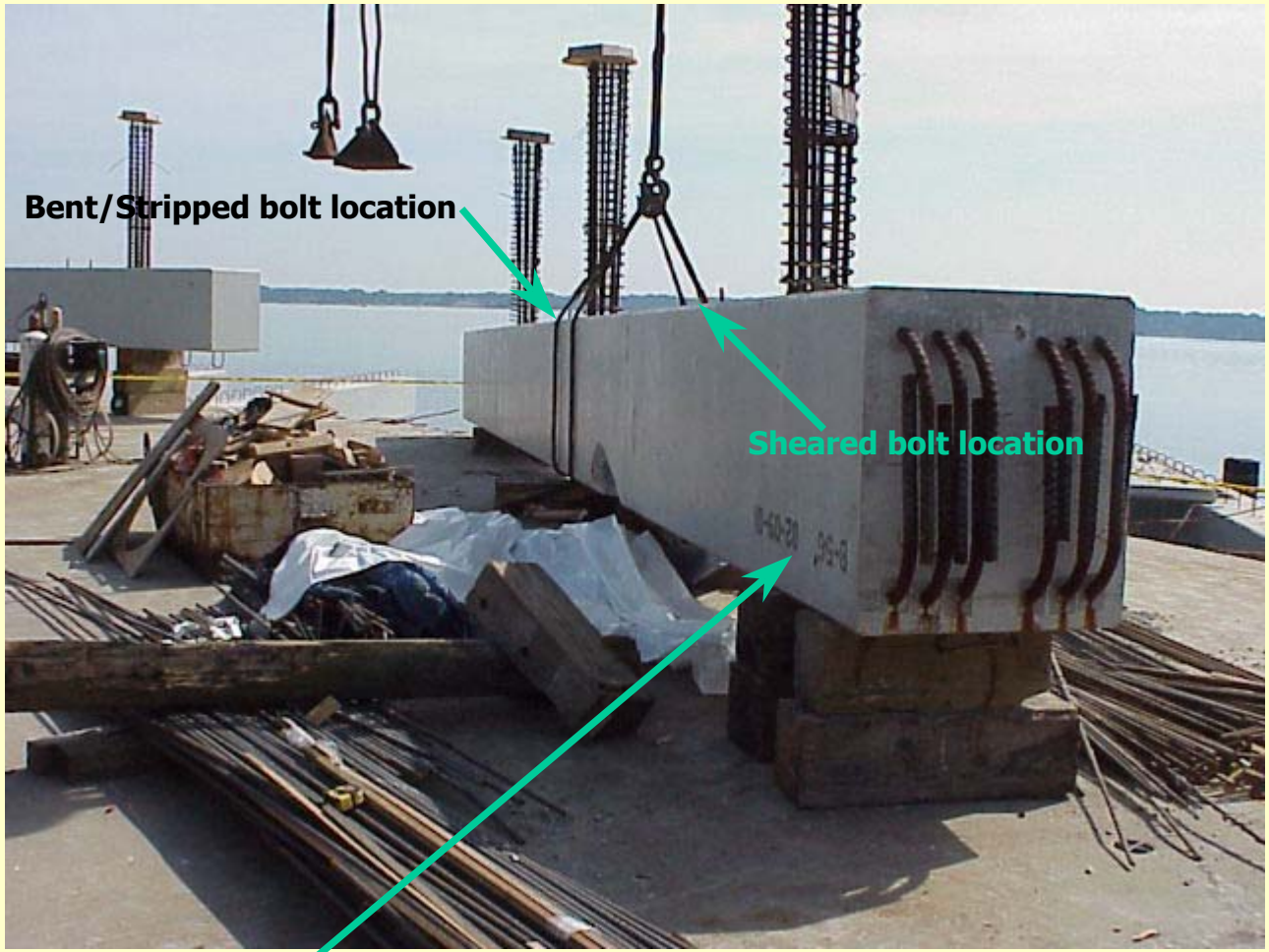
Crane Accident

Typical pile cap rotation prior to placement (June 2001)

Crane Accident

Typical pile cap after rotation and prior to placement (June 2001)

Crane Accident



Pile cap Bent 56 after accident (16 July 2001)

Crane Accident

Sheared bolt from Pile cap Bent 56 after accident (16 July 2001)

Crane Accident

Other end of sheared bolt with washers and nuts (16 July 2001)

Crane Accident

Closeup of sheared bolt with washers and nuts (16 July 2001)

Crane Accident

Bent/Stripped bolt of Bent 56 pile cap looking north (16 July 2001)

Crane Accident

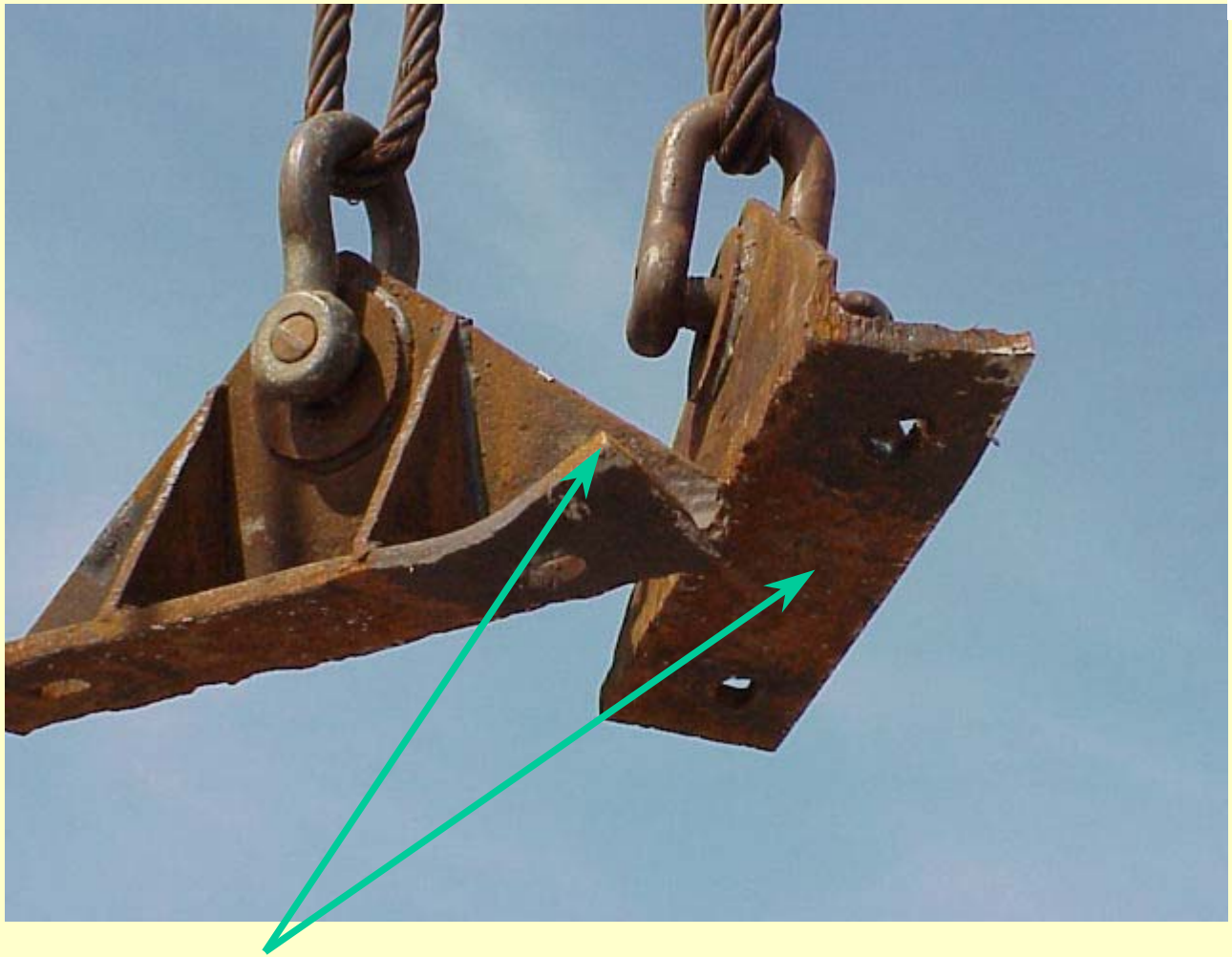
Closeup of Bent/Stripped bolt of Bent 56 pile cap (16 July 2001)

Crane Accident

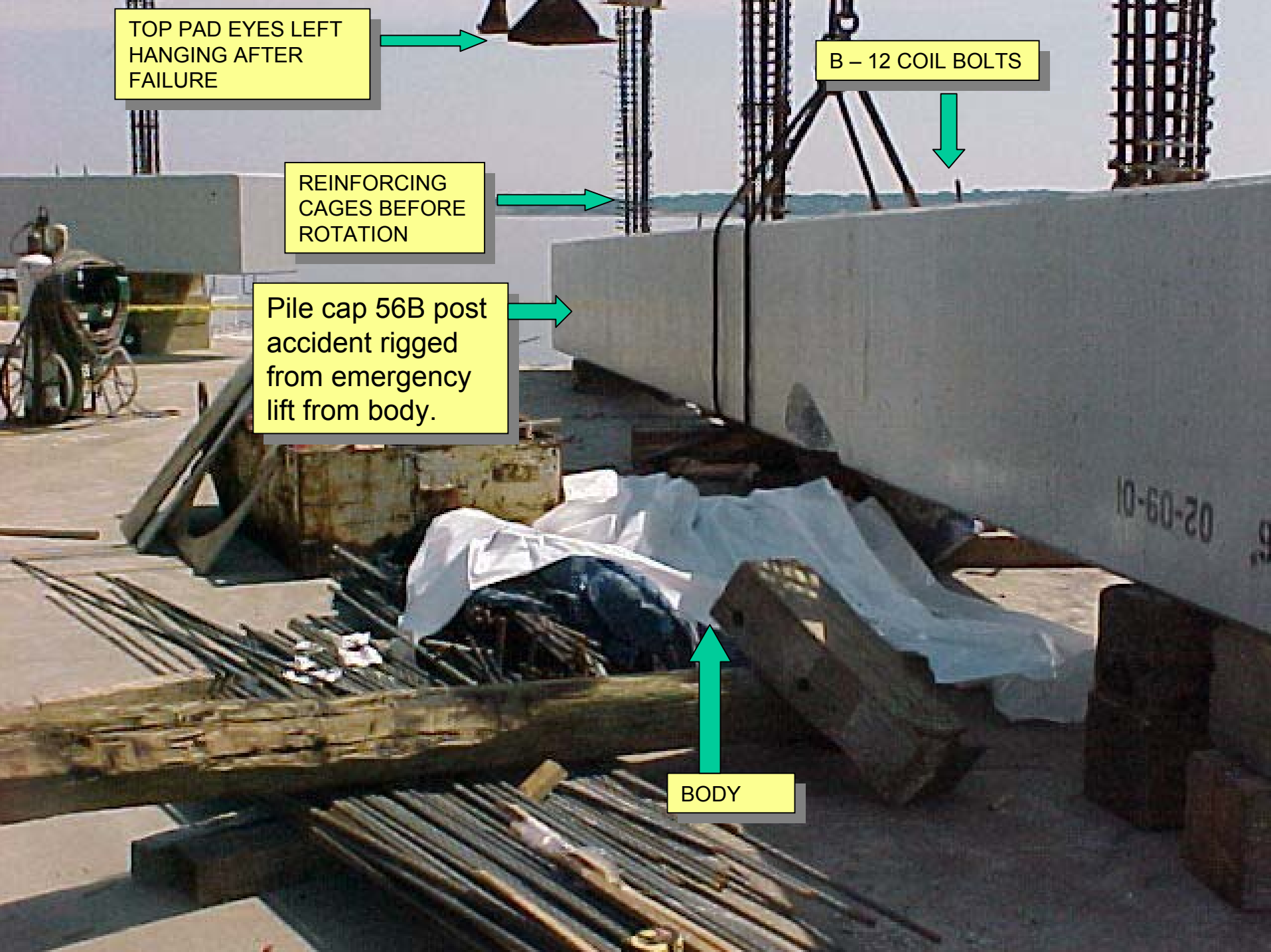
Typical padeye without washers and nuts on Bent 65 pile cap (16 July 2001)

Padeye is not mounted correctly in this example purely for illustration.

Crane Accident



Padeyes from Pile cap Bent 56 after accident (16 July 2001)


TOP PAD EYES LEFT HANGING AFTER FAILURE
B – 12 COIL BOLTS
REINFORCING CAGES BEFORE ROTATION
Pile cap 56B post accident rigged from emergency lift from body.
BODY


BOTTOM PAD EYE THAT WAS BEING INSTALLED


Obvious possible reason
For boom failure
(bent and heavy rust)


Bent
Lattice

CONTRACTOR QC & GOVERNMENT QA CRANE REQUIREMENTS

TYPES OF CRANES

KEY DEFINITIONS

CONTRACTOR REQUIREMENTS

GOVERNMENT QA OVERSIGHT RQMTS.

CONTRACTING OFFICER RESPONSIBILITY

(P-307 1.7.2.1)

1. **Provide oversight of all contractor crane operations & compliance with ASME, Contract, & Local Regs.**
2. **Insure Contractor Accident Investigation & reporting to NCC**
3. **Follow up corrective actions in Event of Crane Mishap**

TYPES OF CRANES

CATATORY I

PORTAL, HAMMERHEAD, DERRICKS LOCOMOTIVE, FLOATING, TOWER, CONTAINER MOBILE CRANES, AIRCRAFT CRASH CRANES

MOBILE CRANES (EXCEPT CAT. IV INCLUDE TRUCK, CRUISER, CRAWLER, WAREHOUSE/ INDUSTRIAL, DRAGLINE USE, PILE DRIVING USE CLAMSHELL, MAGNET AND BUCKET WORK

MOBILE CRANES

Lattice Boom Crane

Hydraulic Boom Crane

MOBILE CRANE DEFINITION

A CRANE MOUNTED ON A TRUCK OR CRAWLER

HYDRAULIC TRUCK CRANE

HYDRAULIC BOOM TRUCK MOUNTED CRANES

TYPICAL "ROUGH TERRAIN" CRANES

HYDRAULIC TRUCK CRANE

LOAD LINE WITH REEVED BLOCK MAIN HOIST

WHIP LINE WITH "HEADACHE BALL" AUX. HOIST

TYPES OF CRANES
CATEGORY 2 & 3

CATEGORY 2 GREATER THAN 20,000 LBS
CATEGORY 3 LESS THAN 20,000 LBS CAPACITY

Overhead Traveling, Gantry Rail Mounted, Wall, Jib, Pillar, Pillar Jib, Monorail with Hoists, Fixed Over-Head hoists including chain-falls designed to use at the Same location, Pedestal mounted commercial boom Assemblies (fixed length, telescoping and articulating) Attached to truck, trailers, flatbeds, or railcars or Stationary mounted to piers with capacities less than 20,000 pounds.

TYPES OF CRANES
CATEGORY 4

COMMERCIAL TRUCK MOUNTED ARTICULATING BOOM, PEDESTAL MOUNTED COMMERCIAL BOOM ATTACHED TO STAKE TRUCKS, TRAILERS FLATBEDS OR RAILCARS OR STATIONARY MOUNTED ON PIERS WITH A CAPACITY GREATER THAN 2000 LBS.

BOOM TRUCK TYPE CRANES

BOOM TRUCK TYPE CRANES

HYDRAULIC BOOM

TWO TYPES OF OUTRIGGERS (STABILIZER)

CAT 2 GREATER THAN 20,000 LBS

NOTE: WHEELS OFF THE GROUND

ARTICULATING BOOM CRANES

ARTICULATING BOOM

PEDESTAL MOUNTED

PEDESTAL MOUNTED COMMERCIAL CRANE

HYDRAULIC CRANE WITH JIB STOWED

STANDARD OPERATING PROCEDURES for CONTRACTOR CRANE QA OVERSIGHT

A standard procedure for the oversight/verification of safe contractor crane operations to reduce risk exposure from crane accidents.

CRANE OPERATORS

PROVIDE QUALIFIED CRANE OPERATORS AS PER COE-385-1-1 16.C.05 & APPENDIX "G"

QUALIFIED FOR SPECIFIC CRANE OR DERRICK

WRITTEN OR ORAL EXAM AND PRACTICAL EXAM UNLESS SATISFACTORY EVIDENCE OF EXPERIENCE AND QUALIFICATION. LICENSE ISSUED BY A QUALIFYNG SOURCE (Appendix "G" 1 C) Valid 3 years

PHYSICAL QUALIFICATION EXAM
PHYSICIANS CERTIFICATION REQUIRED
INCLUDES VISION TEST
Valid for one year (16.C.05 a (3) b

CRANE ADMINISTRATIVE REQUIREMENTS

ITEMS REQUIRED TO BE WITH EVERY CRANE
(3 REQUIRED ITEMS)
(16 C.02 a, b, c)

1. MANUFACTURER'S OPERATING MANUAL
2. LOAD RATING CHART

Make, Model, Serial # & Year of Crane
Load Ratings for all configurations including crane optional equipment.
Load Line Reeving Recommendations
Operating limits for windy or cold conditions

3. CRANE LOG BOOK. A RECORD OF ALL OPERATING HOURS, CRANE INSPECTIONS & TESTS, MAINTENANCE & REPAIR WORK

LOG UPDATED DAILY SIGNED BY BOTH OPERATOR AND SUPERVISOR

SERVICE MECHANICS SIGN LOG AFTER ALL MAINTENANCE & REPAIR WORK.

CRANE LOG BOOK

A CRITICAL DOCUMENT

1. **SHOULD PROVIDE WRITTEN EVIDENCE OF ALL TESTS INCLUDING LOAD AND PERFORMANCE TESTS**

2. **EVIDENCE OF ANY LOAD BEARING, LOAD CONTROLLING. OPERATIONAL SAFETY DEVICE, OR COMPONENT, BRAKE, TRAVEL COMPONENT, OR CLUTCH HAS BEEN ALTERED, REPLACED, OR REPAIRED**

EXAMPLES OF OPERATIONAL SAFETY DEVICES

LIMIT SWITCHES

ANTI-TWO BLOCK

SHUT DOWN WINCH/ALARM

RADIUS INDICATORS

BOOM ANGLE INDICATORS

BOOM LENGTH INDICATORS

LOAD SCALES

LOAD MOVEMENT INDICATORS (LMI)

CRANE MANDATORY EQUIPMENT

(16.D.01- 16.D.05 & Specification section 01525)

1. **Boom Angle or Radius Indicating Device**
2. **Anti-2 blocking (upper limit) Device.**
   (except articulating & duty cycle work cranes)
3. **Load Indicating Device**
   also called a (Load Move Indicator)
4. **Means for operator to determine levelness**

CAB MOUNTED BOOM ANGLE INDICATOR

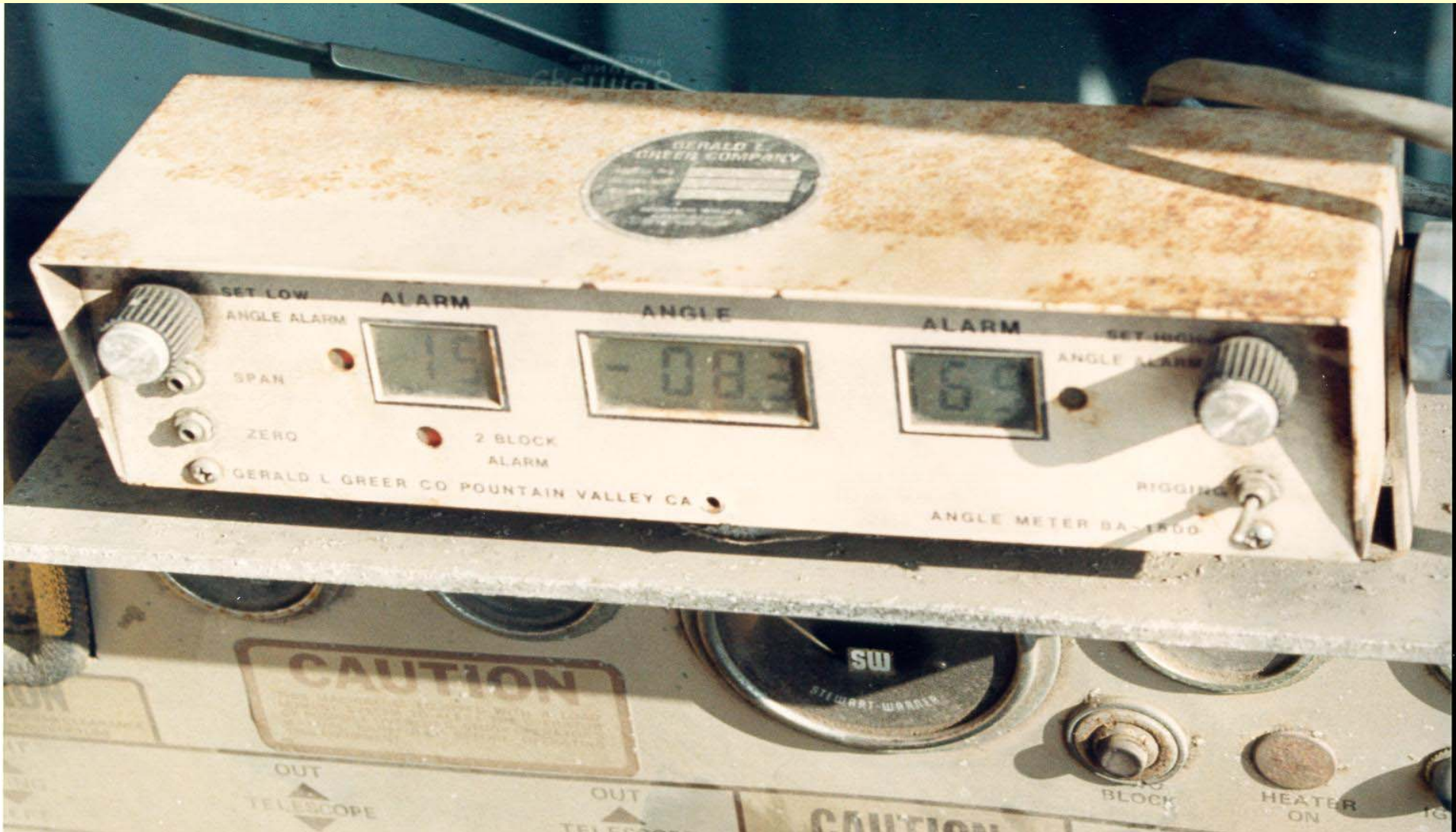
SOME USE MECHANICAL LINKAGE TO ALLOW MOUNTING INSIDE THE OPERATORS CAB

BOOM ANGLE INDICATORS

MOST BOOM ANGLE INDICATORS ARE SIMPLE,WEIGHTED MECHANICAL DEVICES

CABLE OPERATED BOOM ANGLE INDICATOR

DIGITAL BOOM ANGLE INDICATOR



LOAD MOVEMENT INDICATORS (LMI)

An electronic device in the cab of a crane that indicates to the crane operator the load weight, maximum weight he can pick up at the current configuration, the boom angle and load radius.

LOAD MOVEMENT INDICATOR

Operator enters input into the LMI
Configuration of crane
Weight rigging/Block
Counter Weights, etc.

To be verified with the crane load rating chart as crane is set-up!

LEVEL INDICATOR

Bubble inside circle indicates Crane is level to within 1º

CONTRACTOR CRANE INSPECTION REQUIREMENTS

1. **COMPLETE 25 POINT PERIODIC INSPECTION (When Crane First Arrives at the Jobsite)(Pg)**
2. **COMPLETE 14 POINT START-UP INSPECTION (Prior to every shift the crane is to be operated)(Pg)**
3. **COMPLETE CERTIFICATE OF COMPLIANCE (Post in the cab or the vehicle/crane)(Pg)**
4. **COMPLETE AND/OR PROVIDE DOCUMENTATION OF OPERATIONAL PERFORMANCE TESTING**
5. **COMPLETE AND/OR PROVIDE DOCUMENTATION OF LOAD PERFORMANCE TESTING**

PERFORMANCE TESTS

(Appendix "I")

Who performs performance tests?

16.C.13 a. Performance tests shall be conducted by a qualified person, in accordance with the manufacturer's recommendations; at the minimum according to Appendix "I"

PERFORMANCE TEST RECORDS

16.C.13 b. Written reports of the performance test, showing test procedures and conforming to the adequacy of repairs or alterations, shall be maintained with the crane or derrick or at the on-site project office.

Where should a QA Inspector find a record of the performance tests?

PERFORMANCE TEST DEFINITION

A TEST TO DETERMINE THE PROPER OPERATION OF A CRANE & THE ABILITY OF THE CRANE TO SAFELY LIFT LOADS WITHIN ITS PERFORMANCE RATING.
PERFORMANCE TEST INCLUDE:

(1) OPERATIONAL PERFORMANCE TESTS
(2) LOAD PERFORMANCE TESTS

(COE 385-1-1 PAGE 296)

WHEN IS THE OPERATIONAL PERFORMANCE TESTS COMPLETED?

16.C.13 c (1) Before initial use of cranes in which a load bearing, load controlling, or operational Safety device or component, brake, or travel component, or clutch have been altered, replaced, or repaired.

(2) Every time it is reconfigured or reassembled after disassembly, and

(3) Every year.

WHEN IS A LOAD PERFORMANCT TEST COMPLETED?

16.C.13 d. Under the following circumstances, cranes Shall be given a load performance test. (1) before initial Use of cranes in which load bearing, load controlling Operational Safety Device, component, brake, or travel component, or clutch have been altered, replaced, or repaired (2) every time the crane is reconfigured or reassembled after disassembly
(3) every four years.

PERFORMANCE TEST & LOAD TEST QUESTION

A contractor's crane arrives with all the appropriate documentation and equipment on his hydraulic mobile crane. His log book indicates his last performance test was 7 months ago and load test was 3 years ago.

DOES HE HAVE TO DO ANY TEST?

LOAD PERFORMANCE QUESTION

A lattice boom crane is being assembled At your jobsite according to the Manufacturer's instructions. The Contractor states he is going to do a Performance test and a Load Performance Test. He asks you, what weight do I have To use for the load performance test?

Contractor is to provide a load to lift at the jobsite that has a known weight.

Using this known weight, refer to The load rating chart to determine The maximum radius for that load.

Perform the load tests at that Radius for the known load.

Note: **See definition for Load Test. COE 385-1-1 Pg. 295**

CRANE QA RESPONSIBILITIES

1. Verify crane operators Qualifications
2. Verify administrative items with crane
3. Verify mandatory equipment part of crane
4. Verify contractor 25 point Periodic Inspection
5. Verify contractor 14 point Start-up Inspection
6. Verify completion of Certificate of Compliance and posted in the cab.
7. ROICC Complete QA Spot-Check
8. Observe Operational performance Test **
9. Observe Operational Load Performance Test**

** If these items apply

CRITICAL LIFT

Critical Lifts include:

a. Lifts made when the load weight is 75% of the rated capacity of the crane (at the configuration)

b. Lifts that require the load to be lifted, swung, or placed out of the operators view

c. Lifts made with more than one crane.

d. Lifts involving non-routine or technically difficult rigging arrangement

e. Hoisting personnel with a crane or derrick

f. Any lift which the lift or crane operator believes should be considered critical.

(Critical lift plan checklist)

TECHNICALLY DIFFICULT RIGGING DEFINITION

1. **The center of gravity is questionable**
2. **The structural integrity of the load is questionable**
3. **The attachment points on the load are not clearly evident**
4. **A satisfactory rigging configuration is difficult to determine**
5. **Forces generated in & by the rigging configuration are Difficult to determine**
6. **A difficult rigging configuration has to be reassembled for a Particular lift and a possibility exists for it to be reassembled Incorrectly or for required pieces to be left out**
7. **A lift involving a submerged load.**
8.


Barge
Mounted
Floating
Crane

SPECIAL REQUIREMENT BARGE MOUNTED CRANES

LOAD CHART AND CRANE CERT
NOT VALID ON BARGE (Shore Cert not valid)

1. **Barge stability calculations are to be done, And reduced capacity load charts provided Based on list and trim. (not to exceed 3 degrees)**
2. **Crane to be load tested to verify list & trim Test load 110% (+5%-0%)of the reduced Load capacity chart and re-certified.**
3. **(1)New load chart, (2)list and (3)trim indicators to be in the crane operators cab.**

CRANE CERTIFICATION TYPES

INITIAL FACTORY LOAD TESTS
110 % OF CRANE RATING
(Mobile Cranes-125% Fixed Cranes)

COMPLETE PERFORMANCE AND ANCILLARY EQUIPMENT TESTING

CONTRACTOR OWNED CRANES

CONTRACTOR OWNED & OPERATED CRANES USED IN CARGO TRANSFER, FLOATING CRANES, BARGE MOUNTED MOBILE CRANES & LONG SHORING OPS. THE 3RD PARTY CERTIFICATION IS TO BE DONE BY AN OSHA ACCREDITED AGENCY ACCORDING TO OSHA REGULATIONS.

CONTRACTOR OWNED & OPERATED CRANE QUESTION

After the initial manufacturer's Testing of a crane, what testing Is required to be completed by The owner of the crane and How often are these tests done?

PERFORMANCE TESTING

1. **PERFORMANCE TESTS WITHOUT LOADS EVERY YEAR**

2. **PERFORMANCE TEST WITH A LOAD EVERY 4 YEARS**

CHECKING CRANE SET-UP

CRANE QA SPOT-CHECK LIST

#5. Weight of load known by operator

#6. Load within rated capacity as set-up
Verify LMI with trial set-up.

#9/10/11. Outriggers & Swing Radius

#21. Overhead power lines/safe Clearance

#28 AHA completed and Accepted

#29 Mandatory Safety Equipment

VERIFY LMI TO LOAD RATING CHART

MAKING A TRIAL RUN
MEASURE/VERIFY RADIUS
CONFIRM BOOM LENGTH
CONFIRM WEIGHT OF LOAD

COMPARE INFORMATION TO LOAD MOMENT INDICATOR

CRANE SET-UP

IS THE CRANE LEVEL?
WILL GROUND SUPPORT CRANE?
WILL CRIBBING BE USED?
SWING RADIUS GUARDED?
OUTRIGGERS FULLY EXTENDED?

LOAD RATING CHART

Load Radius
Boom Length
Lift Capacity
Rear/side

Deductions:
- **Rigging**
- **Load Block**
- **Stowed items**

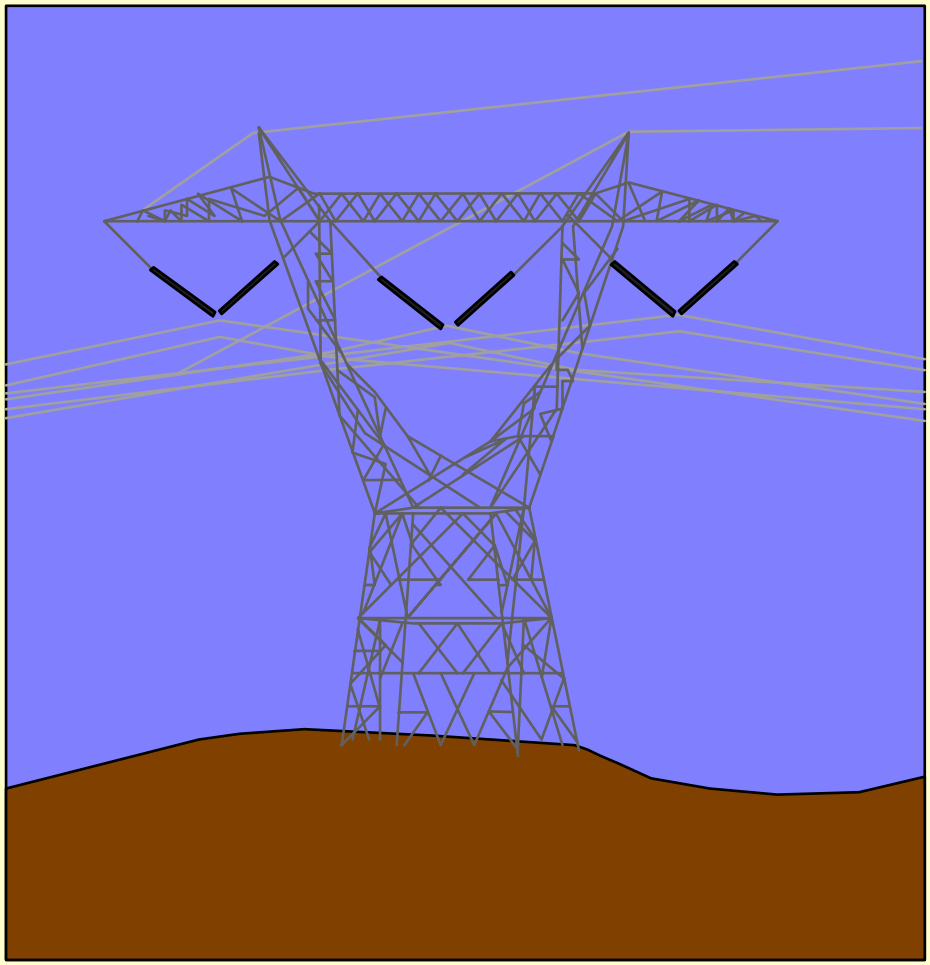
IN POUNDS ON OUTRIGGERS

OUTRIGGERS FULLY EXTENDED - OVER REAR

Radius in Feet	Main Boom Length in Feet (Power Pinned Fly Retracted)									Power Pin. Fly Ext. & 141 ft.
	46	58	70	82	94	106	118	130	141	173
10	300,000 (74.5)									See Warning Note 17
12	280,000 (72)	143,500 (76)	142,000 (79)							
15	235,000 (67.5)	143,500 (72.5)	141,500 (76.5)	130,000 (78.5)						
20	173,500 (60.5)	143,500 (67.5)	123,500 (72)	112,000 (75)	102,000 (77.5)	90,300 (79.5)				
25	135,500 (52)	131,500 (61.5)	110,500 (67.5)	98,650 (71)	89,250 (74)	78,550 (76.5)	73,700 (78.5)	69,300 (80)		
30	106,000 (43)	106,000 (55.5)	98,000 (63)	88,350 (67.5)	78,750 (71)	69,250 (73.5)	65,100 (76)	61,000 (77.5)	60,000 (79.5)	
35	84,700 (30.5)	84,700 (49)	84,700 (58)	80,150 (63.5)	69,000 (67.5)	60,750 (70.5)	57,150 (73)	54,000 (75.5)	52,150 (77.5)	
40		70,500 (41)	70,500 (52.5)	70,500 (59.5)	61,300 (64)	54,000 (67.5)	50,600 (70.5)	48,300 (73)	45,850 (75)	38,000 (79)
45	See Warning Note 16	58,850 (32)	58,850 (47)	58,850 (55)	55,000 (60.5)	48,500 (64.5)	45,200 (68)	43,050 (71)	40,400 (73)	35,750 (77)
50		49,600 (17.5)	49,600 (40.5)	49,600 (50.5)	48,750 (57)	43,050 (61.5)	40,700 (65)	38,250 (68.5)	35,750 (71)	32,100 (75.5)
60			36,200 (22.5)	36,200 (39.5)	36,200 (48.5)	34,300 (55)	33,600 (59.5)	30,750 (63.5)	28,500 (66.5)	26,350 (72)
70				26,050 (25)	26,050 (39.5)	26,050 (47.5)	26,050 (53)	24,750 (58)	23,100 (61.5)	22,000 (68.5)
80					18,850 (27)	18,850 (39)	18,850 (46.5)	18,850 (52.5)	18,700 (56.5)	18,500 (64.5)
90						13,500 (28)	13,500 (38.5)	13,500 (46.5)	13,500 (51.5)	15,250 (60.5)
100							9,390 (29)	9,390 (39)	9,390 (45.5)	12,600 (56.5)
110							6,080 (12.5)	6,080 (30.5)	6,080 (39)	10,100 (52)
120								3,390 (17.5)	3,390 (31)	7,530 (47.5)
130									1,150 (19.5)	5,390 (42.5)
140										3,610 (36.5)
150										2,100 (30)
Minimum boom angle (deg.) for indicated length (no load)									10	19
Maximum boom length (ft.) at 0 deg. boom angle (no load)									140	167

NOTE: Boom angles are in degrees.

CRANE CRITICAL CLEARANCES



POWER LINES
DE-ENERGIZED
VISIBLY
GROUNDED
WHEN POSSIBLE

OVERHEAD POWER LINE CLEARANCE REQUIREMENTS

SAFE CLEARANCE MINIMUM OF 10 FEET RADIUS UP TO 50,000 VOLTS

PLUS .4” FOR EVERY 1000 VOLTS 0VER 50,000 VOLTS

Eg: 125 KV Requires (.4 x 75)=30” + 10’=12’6”

See COE table 11-3 page 177

FLOATING CRANE CLEARANCE

A MINIMUM OF 20 FEET OF CLEARANCE IS REQUIRED FOR FLOATING PLANT AND ASSOCIATED EQUIPMENT FROM OVERHEAD POWER TRANSMISSION LINES (COE-11.E.06)

OTHER OPERATION CONSIDERATIONS

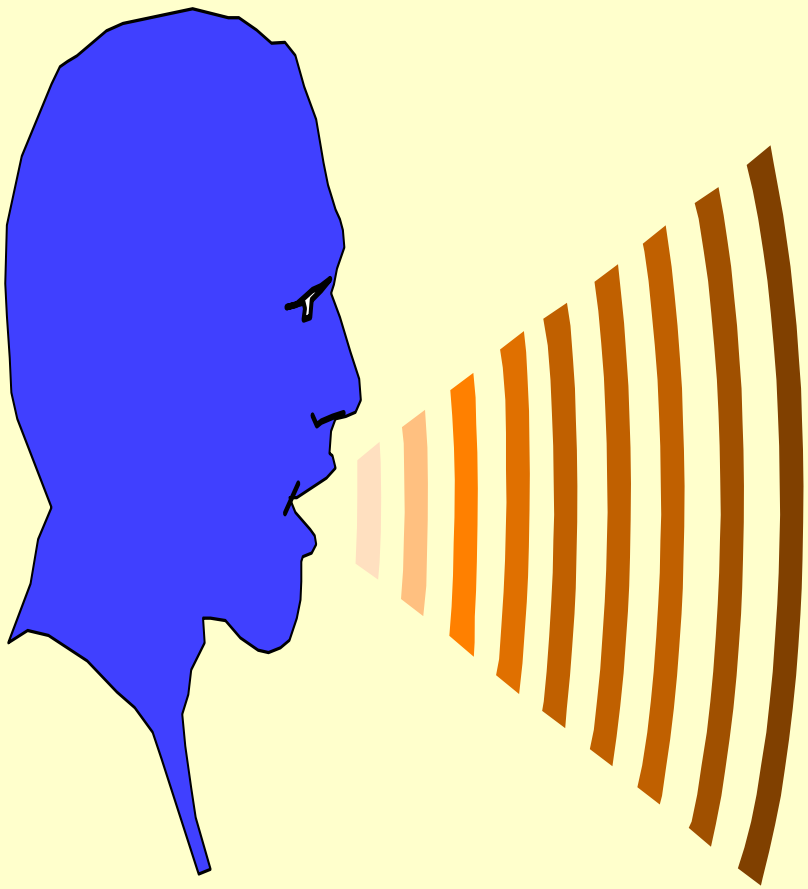
Counterweight clearance/guarded

Pinch Points/guarded/lined off

Weather conditions:

- **Wind (Manufacturer's Recommendation)**
- **Icing and Reduced Visibility**
- **Lightning (All operations stop)**
- **Night special lighting required**

COMMUNICATIONS



Hand Signals
Direct Voice
Radio
Blind/Complex required that constant communication with operator

ELECTRONIC EMISSION INTERFERENCE (EMI)

Applies to crane electronic equipment
Controls, Load Indication Devices, etc.

Sources of interference:

- **Ships radar**
- **Transmission Towers**
- **Small two-way radios**
- **Aircraft tower communications**

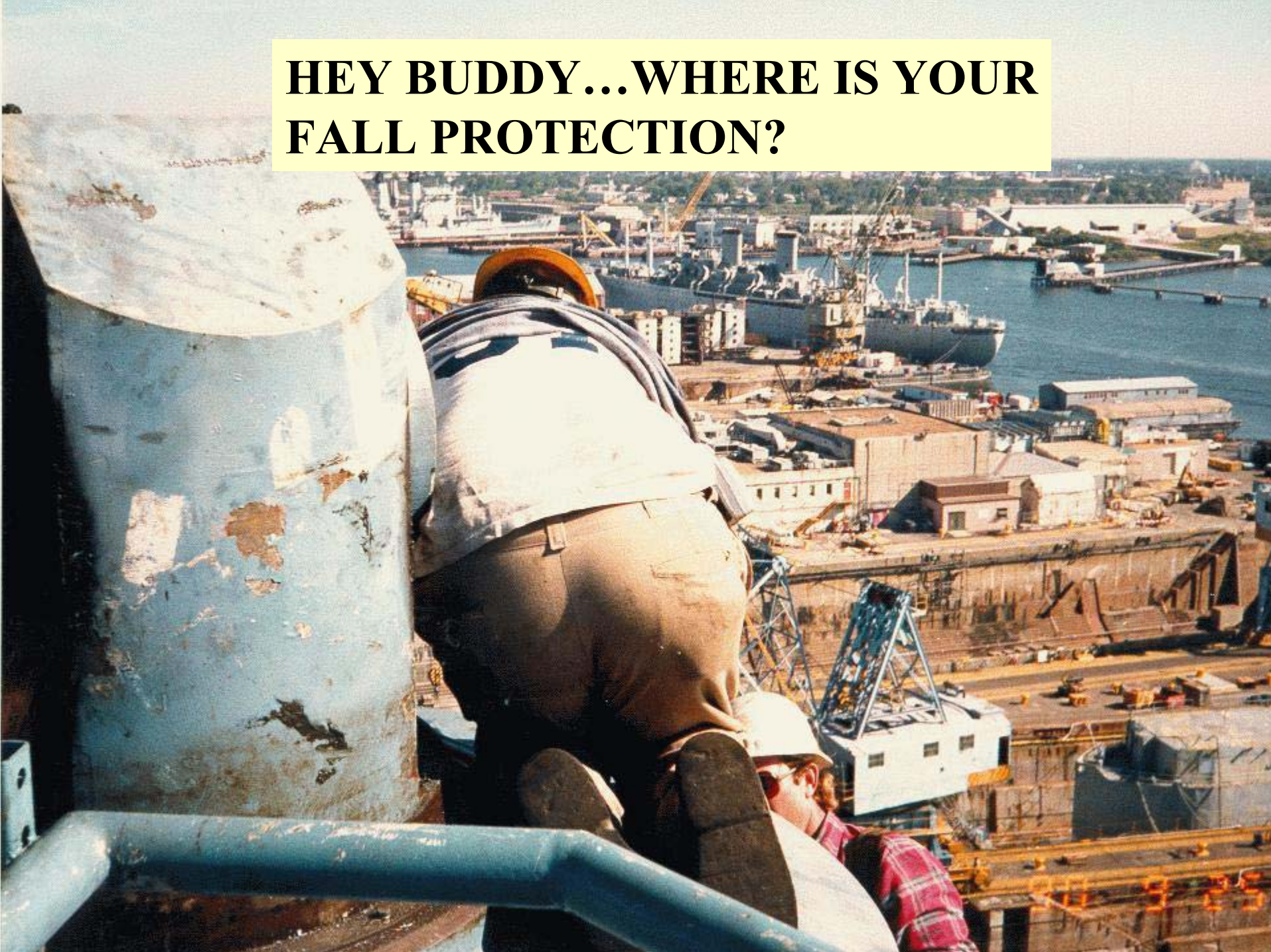
Activity Hazard Analysis

AN AHA SHALL BE DEVELOPED AND IMPLEMENTED FOR CRANE SET-UP, AND SET-DOWN PROCEDURES (MOBILIZATION, ASSEMBLY OR ERECTION, DISMANTLING & DEMOBILIZATION) (16.C-08)

PERSONNEL LIFTING WITH CRANES

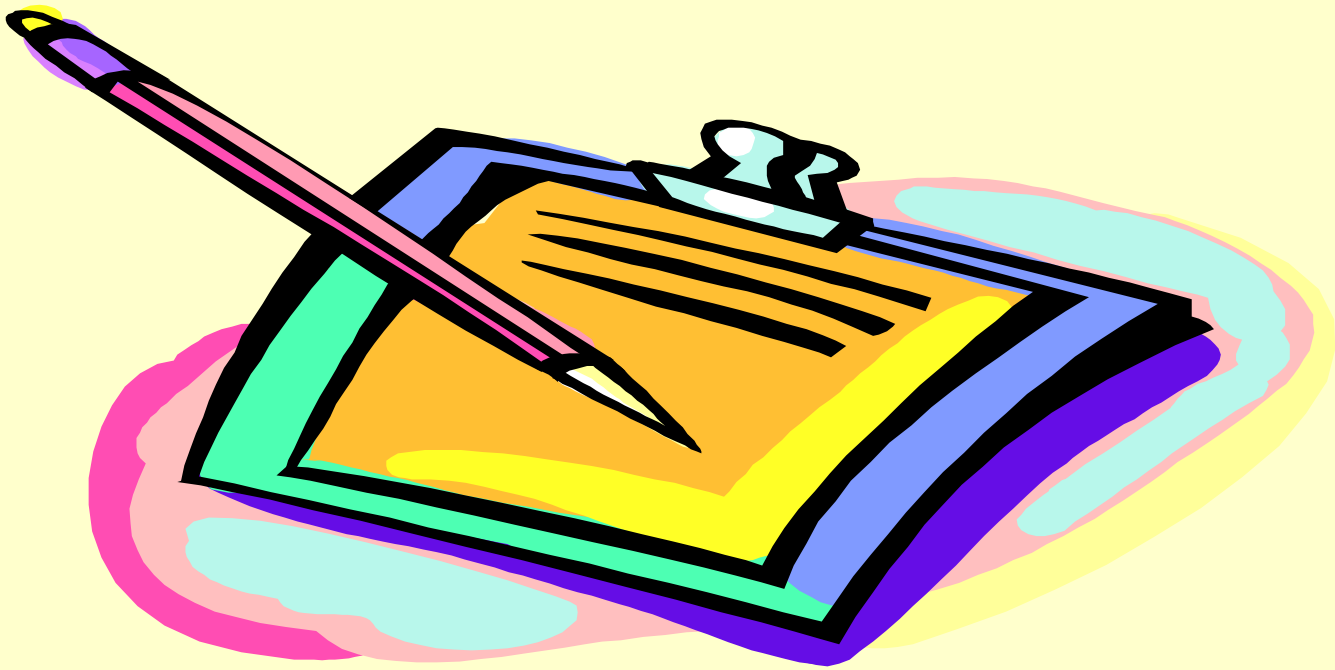
ONLY USE CRANES WHEN NO SAFER METHOD EXISTS

FOLLOW REQUIREMENTS OF 29 CFR 1926.550 & COE 21.G
MOST STRINGENT APPLIES!


HEY BUDDY…WHERE IS YOUR
FALL PROTECTION?

CRANE SAFETY VIDEO

“CRANE SAFETY LIFT CALCULATIONS”



CRANE SET-UP WORKSHOP

CRANE ARRIVES AT YOUR JOB

1. **ALL OPERATORS QUALS OK**
2. **ALL PAPERWORK VERIFIED**
3. **ALL MANDATORY EQUIPMENT IS VERIFIED AND OK**
4. **CRANE IS SET-UP AS FOLLOWS**

CRANE SET-UP INFORMATION

Load: AHU to be set on roof top
40 Ton P&H Hydraulic Crane
The crane has an on-board
Load Movement Indicator but
Operator and QA Inspector need
To verify the readings.

CRANE SET-UP INFORMATION

Questions based on the Mobile Crane Set-up Sketch & Crane Load Chart See pages 123-126 in Safety Resource 3-Ring Binder.

Note: After load weight is known, Don't forget deductions for boom Hoist block and all rigging.

SET-UP QUESTIONS

1. WHAT IS THE LOAD RADIUS? (LOAD CENTER OF ROTATION)
2. NAME AT LEASE TWO WAYS YOU COULD FIND OUT THE WEIGHT OF THE AHU?
3. WHAT OTHER MEANS CAN BE USED TO ESTIMATE THE WEIGHT OF A LOAD?

SET-UP QUESTIONS

4. WHAT IS THE MAXIMUM WEIGHT THIS CRANE CAN LIFT AT THE CONFIGURATION SHOWN ON THE SKETCH AFTER ALL DEDUCTIONS ARE MADE?

SET-UP QUESTIONS

5. IF THE AHU WEIGHED 10,000 LBS. COULD THIS CRANE PICK UP THIS LOAD AS IT IS SET-UP ACCORDING TO THE SKETCH?

SET-UP QUESTION

6. ASSUMING THE ANSWER TO QUESTION #5 WAS YES…WHAT DESIGNATION WOULD YOU CONSIDER THIS LOAD TO BE?